

## MECONIUM IN HEALTH AND DISEASE J T Harries

### MECONIUM IN HEALTH AND DISEASE

J T HARRIES MRCP MSc MD

*Institute of Child Health  
University of London  
and  
The Hospital for Sick Children, London*

- 1 Sources of meconium
- 2 Meconium in health
  - a Water and inorganic elements
  - b Enzymes
  - c Plasma proteins
  - d Glycoproteins
  - e Lipids
  - f Haemoglobin metabolites
  - g Steroids and bile acids
  - h Sterols
- 3 Meconium in disease
  - a Cystic fibrosis
  - b Other disease states
- References

Meconium can be defined as the first stools passed by a newborn infant, the first stool being passed within 24 hours of birth by more than 90% of newborns. It is a viscid, odourless, greenish-black, sterile material containing little fat or protein, and consisting predominantly of carbohydrate-containing substances; its characteristic colour is due to bile pigments such as bilirubin. Because of its sterility, in contrast to faeces, its components represent enteric metabolites derived from the maternal-fetal placental unit. The mean pH of meconium is 6.1. A meconium-like plug of material is present in the colon as early as the fourth month of fetal life.

This paper will review current knowledge on the sources of meconium, and its composition in health and disease states.

#### 1 Sources of Meconium

The precise origin of the components of meconium has not been defined. Nevertheless the two most important sources must be the amniotic fluid and the secretions of the fetal alimentary tract. The electrophoretic pattern of amniotic fluid proteins has been shown to be identical to that of proteins in meconium of infants with meconium ileus secondary to cystic fibrosis, suggesting that meconium proteins are primarily derived from amniotic fluid (Young *et al.* 1958). Amniotic fluid contains substances synthesized by the amnion, fetal bronchial secretions and urine, and maternal vascular transudate. The fetus ingests amniotic fluid equivalent to 10% of its body weight/24 hours at 4 months, and more than 300 ml/24 hours at term (Pritchard, 1966). The composition of meconium does not accurately reflect that of amniotic fluid since it is modified by fluid shifts and enzymic activity during its passage down the fetal alimentary tract. In addition, during the fourth to seventh months of fetal life,

intraluminal contents enter the surface epithelial cells to form ovoid "meconium corpuscles" which, following lysosomal modification, return to the intestinal lumen (Schmidt, 1971). To what degree this process affects the final composition of meconium is not clear.

Bile, and pancreatic and intestinal secretions contribute to the composition of meconium; the fetal liver and gastrointestinal tract can synthesize steroids, and therefore the components of meconium may represent biliary and intestinal metabolites which can participate in an enterohepatic circulation (Kinsella & Francis, 1971). The tissue debris in meconium is largely derived from desquamated cells from mouth, skin, alimentary tract, vernix and lanugo hair (Smith, 1959). The soluble proteins in meconium are predominantly derived from amniotic fluid and intestinal secretions, the albumin content reflecting ingestion of albumin from amniotic fluid (Schutt & Isles, 1968).

#### 2 Meconium in Health

The qualitative and quantitative patterns of the individual constituents of meconium in health will now be considered.

##### a Water and Inorganic Elements

About 70-75% of the total wet weight of meconium is water (Hall & O'Toole, 1954) and it contains high concentrations of inorganic materials, which include sodium, potassium, calcium, magnesium, phosphate, copper, zinc, iron and manganese (Kopito & Shwachman, 1966).

##### b Enzymes

Proteases (e.g. trypsin, chymotrypsin, rennin, dipeptidases, acid proteases), glycosidases (e.g. maltase, isomaltase, sucrase, lactase, trehalase) and lysosomal enzymes (e.g. phosphatases) are normally found in meconium (Schwarz, 1953; Schachter & Dixon, 1965; Eggermont, 1966; Antonowicz *et al.* 1975). The endopeptidases—trypsin and chymotrypsin—hydrolyse most of the soluble proteins in the intestinal lumen; this accounts for the very low protein content of meconium in health. These two enzymes are also active against mucus glycoproteins secreted into the gut, thereby reducing the viscosity of the mucus. Proteolytic activity begins to appear in meconium at about the 300g stage of fetal development and is most active in the colon (Lieberman, 1966). The enzymes are presumably of pancreatic origin. The function of glycosidases in meconium is not known, but they may promote the synthesis of complex carbohydrates by transglycosidation (Karlson, 1968); their origin is probably the intestinal mucosa and they are susceptible to proteolysis.

##### c Plasma Proteins

Five to 10% of the total dry weight of meconium is composed of plasma proteins and tissue debris, the remaining dry weight being accounted for by enzymes, ions, haemoglobin metabolites, steroids, sterols and mucus glycoproteins; albumin constitutes 0.11% of the total soluble proteins (Rule *et al.* 1970). It is likely that the two most important sources of plasma proteins are ingested amniotic fluid and secretion across the fetal gut from plasma. Except for the protease inhibitors, most plasma proteins are degraded by proteolytic enzymes. IgG is present in meconium, whereas both IgA and secretory IgA are absent (Rule *et al.* 1971). Ryley *et al.*